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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
WERNER, BRIAN P	

ART UNIT	PAPER NUMBER
2621	

DATE MAILED: 12/04/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/294,137	MAEDA ET AL.	
	Examiner	Art Unit	
	Brian P. Werner	2621	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *15 October 2003*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,2,4-7,12-15 and 17-36* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,2,4-7,12-15 and 17-36* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

13)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

a) ☐ The translation of the foreign language provisional application has been received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Response to Amendment

1. The amendment received on October 15, 2003 has been entered. Claims 1, 2, 4-7, 12-15 and 17-36 remain pending.

Response to Arguments

2. Applicant's arguments with respect to the pending claims have been considered but are moot in view of the new ground(s) of rejection.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1, 4, 5, 22 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Lee et al. (US 5,808,735 A – art of record) and Maeda et al. (US 5,153,444 A – new art). Lee discloses a system that aligns and compares first and second images (i.e., a test and reference image of a semiconductor) to detect defects. The content of the Lee reference as addressed the previous Office Actions is incorporated herein by reference, and will not be repeated for the sake of

brevity. Regarding the claims as amended, Lee teaches aligning the first and second images, and then after the alignment, adjusting the brightness of one of the first and second images to match a brightness of the first image with a brightness of the second image ("once the test and reference images are aligned in three dimensions and normalized for intensity ..." at column 6, line 41; Lee discloses gradation conversion means for performing gradation conversion to correct a brightness, and thereby match the brightness of one image to that of the other, i.e., "test and reference images differ slightly in intensity" and the "system 20 compensates for these normal intensity differences (step 220) by providing an intensity offset" at column 6, line 15; figure 2A, numeral 220; "normalized for intensity" at column 6, line 42; as described at column 6, lines 30-33, the intensity values of the images are made to correspond more closely with one-another, or corrected with respect to one-another, based on a histogram of differences). While Lee's alignment is a "conventional alignment" at column 4, line 54, and while conventional alignments have an accuracy of one pixel or less (i.e., sub-pixel accuracy), Lee does not specifically teach the alignment of the two images with an accuracy of one pixel unit. Lee is silent about the accuracy because an accuracy of one or fewer pixels is so well know in the art, it is not necessary to mention. Maeda teaches a system in the same field of comparing two images for defects ("... a defect in the pattern is recognized through the comparison" at column 4, line 23), wherein Maeda teaches a conventional alignment of the two images ("the aligned two patterns" at column 4, line 22) with an accuracy of one pixel unit ("pixel-wise alignment" at column 4, line 33; "shifted one pixel at a time" at column 4, line 37). That is, Maeda shifts the

images by one pixel unit at a time until a best alignment is achieved. Given that the images are only shifted by one pixel, the accuracy of the final aligned images have an accuracy of one pixel unit. It would have been obvious at the time the invention was made to one of ordinary skill in the art to utilize, as the unspecified method of conventionally aligning the first and second images of Lee, the convention alignment method taught by Maeda, because it results in the best alignment of the two images (Maeda, "best aligned" at column 4, line 42) using a computationally and mathematically simple algorithm (i.e., "the sum total of the differences becomes a minimum" at Maeda, column 4, line 40) and a mechanically simple method of shifting the images ("stored pattern shifted one pixel relative to the stored pattern" at Maeda, column 4, line 37), thus resulting in speed processing with a reduce cost of hardware given the mere simplicity of the alignment operation.

5. Claims 7, 12-15, 18, 21, 24-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Lee et al. (US 5,808,735 A – art of record) and Maeda et al. (US 5,153,444 A – new art) as applied to claim 22 above, and further in combination with Michael (US 5,640,200 A – art of record). Lee, as part of the Lee and Maeda combination, discloses a system that aligns and compares first and second images (i.e., a test and reference image of a semiconductor) to detect defects as described above, and in the previous Office Actions. Regarding claim 24, While Lee/Maeda discloses a gradation conversion as described above, Lee/Maeda does not further discloses a brightness filter means for adjusting a brightness of one of the

aligned images by filtering al images of the patters to match a brightness of the images. Michael discloses a system in the same field of image processing, and specifically in the same sub-field of comparing a image of a wafer with a reference to detect defects (figure 7), wherein Michael solves the same problem of matching brightness between the two images ("contrast normalization" at column 13, line 65). Michael teaches both a global gradation conversion (i.e., column 13, line 65), which is similar to that already disclosed by Lee, and a local gradation conversion ("local contrast normalization" at column 14, line 32) to locally to locally match a brightness of the first image with a brightness of the second image (equation 6 at column 14, line 40). Michael's local contrast normalization comprises a brightness filter means ("filter" at column 14, line 36) for adjusting a brightness of one of the aligned images by filtering all images of the patters to match a brightness of the images (equation "6", at column 14, line 40). It would have been obvious at the time the invention was made to one of ordinary skill in the art to modify the brightness normalization of Lee (i.e., Lee's global gradation conversion at Lee's figure 2A, numeral 220), to also locally match brightness as taught by Michael, in order to improve matching accuracy by compensating for "conditions that cause image intensity to vary slowly with position in the image" (Michael, column 14, line 35). Lee meets the limitations of claims 25 and 26 as described in the previous Office Actions. Regarding claims 7, 12, 13, 14, 15, 18, 21, 27, 28, 29, all the limitations therein are met by the Lee/Maeda/Michael combination as set forth above.

6. Claims 31 and 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Lee et al. (US 5,808,735 A – art of record) and Maeda et al. (US 5,153,444 A – new art) as applied to claims 1 and 22 above, and further in combination with Teo (US 6,128,108 A – art of record). The Lee/Maeda combination does not teach the local gradation conversion as minimizing a sum of squares of differences between the brightness of the first and second images. Teo discloses a system in the same field of image processing (i.e., "the present invention relates to digital image processing" at column 1, line 5), and same problem solving area of normalizing two images, or matching the brightness of two images ("variation due to different lighting conditions is reduced" at column 2, line 64; images A and B "which were taken under different lighting conditions" at column 8, line 67; "bring the two images into line with one another. Specifically, brightness, contrast and gamma parameters ... are used to modify image color intensity" at column 9, line 7), comprising a local gradation conversion ("once the brightness, contrast and gamma parameters are determined, they are applied to image A" at column 10, line 27; it can be seen from equation 9 that the parameters are applied to each and every pixel as designated by "x,y" and thus the brightness conversion is local, or takes place in local areas) that minimizes a sum of squares of differences between the brightness of the first and second images ("seeks to match as best possible the color intensities of image A ... using a least sum of squares error criterion ... it seeks to minimize the deviation between the color intensities" at column 9, line 23; see equations 3). It would have been obvious at the time the invention was made to one of ordinary skill in the art to

measure and correct the brightness differences between the images of Lee/Maeda, using the minimization of sum of least squares method taught by Tao, in order to reduce variations "due to different lighting conditions" in which the images were acquired (Tao, column 2, line 64), and thereby "bring the two images into line with one another" and specifically, with respect to "brightness, contrast and gamma parameters" (Tao, column 9, line 7), in a speedy and efficient manner (i.e., Tao, "fast modification of the image ... avoiding the need to compute equation (2) repeatedly" at column 10, line 65). In summary, the teaching of Tao would allow for all of the image parameters (i.e., brightness, contrast and gamma) to be normalized between the two images of Lee, instead of just the brightness alone as required, thereby providing a more accurate image normalization and thus further helping to reduce the indication of false defects due to mismatched images (Lee, column 6, line 16).

7. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Lee et al. (US 5,808,735 A – art of record) and Maeda et al. (US 5,153,444 A – new art) as applied to claim 1 above, and further in combination with Haskell et al. (US 6,111,596 – art of record). Lee discloses gradation conversion means for performing gradation conversion to correct a brightness, and thereby match the brightness of one image to that of the other (i.e., "test and reference images differ slightly in intensity" and the "system 20 compensates for these normal intensity differences (step 220) by providing an intensity offset" at column 6, line 15; figure 2A, numeral 220; "normalized for intensity" at column 6, line 42; as described at column 6,

lines 30-33, the intensity values of the images are made to correspond more closely with one-another, or corrected with respect to one-another, based on a histogram of differences). Lee does not teach a linear conversion of the gain and offset so that the brightness of the images can be made equal. Haskell discloses an image process system in the same area of adjusting two images so that their overall brightness is the same ("mismatch in brightness and/or color balance between the two views of a scene due to differences in imaging parameters is rectified" at column 4, line 15), comprising matching the brightness of two images by means of a linear conversion of gain and offset ("gain and offset differences not only for luminance but also for chrominance are corrected" at column 4, line 13; specifically, see "Method 1" at column 6, line 20; "gain and offset values that must be applied to the right-view image to correct for mismatch can be obtained by solving two simultaneous equations" at column 6, line 34; the equation for gain, "a", is at column 6, line 47 and offset, "b" at line 43; the equations are linear [i.e., not exponential] and thus the correction is linear). The technique of method 1 is best applied to "images having histograms with at least two uniquely identifiable points with ... 'very dark' and 'very bright' contents" as described at column 6, line 21. It would have been obvious at the time the invention was made to one of ordinary skill in the art to modify the Lee/Maeda combination by matching the brightness of the Lee using a linear conversion of gain and offset as taught by Haskell, in order to more accurately correct for image brightness difference by factoring in both gain and offset, as opposed to just a simple histogram adjustment as is currently disclosed by Lee, and to provide the additional benefit of correcting a chrominance mismatch (in addition to

the luminance, or brightness) thereby providing Lee the ability to utilize color images, to more accurately represent the semiconductor under inspection.

8. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Lee et al. (US 5,808,735 A – art of record) and Maeda et al. (US 5,153,444 A – new art) as applied to claim 1 above, and further in combination with Wagner et al. (US 5,659,172 – art of record). The Lee/Maeda combination does not disclose picking up the first and second images using an electron beam. Wagner discloses a system in the same field of endeavor of semiconductor wafer inspection ("detection of defects on semiconductor wafers" at column 1, line 11), comprising picking up images to be inspected using an electron beam (figure 1, numeral 32; see "SEM 22 electron beam 32" at column 4, line 64; "images of an area of the semiconductor wafer which is to be inspected" at column 3, line 2). It would have been obvious at the time the invention was made to one of ordinary skill in the art to utilize an electron beam scanner as taught by Wagner, as the image pick-up source of the Lee/Maeda combination, in order to detect defects the size of which "falls below the resolution of conventional light optics" (Wagner, column 1, line 43) because of the scanning microscope's ability to resolve "features more that an order of magnitude smaller than the wavelength of visible light" (Wagner, column 1, line 51), thereby improving defect detection sensitivity and thus accuracy.

9. Claims 32, 33, 34 and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Lee et al. (US 5,808,735 A – art of record), Maeda et al. (US 5,153,444 A – new art) and Michael (US 5,640,200 A – art of record) as applied to claim 7 above, and further in combination with Teo (US 6,128,108 A – art of record). The Lee/Maeda/Michael combination does not teach the local gradation conversion as minimizing a sum of squares of differences between the brightness of the first and second images. Teo discloses a system in the same field of image processing (i.e., "the present invention relates to digital image processing" at column 1, line 5), and same problem solving area of normalizing two images, or matching the brightness of two images ("variation due to different lighting conditions is reduced" at column 2, line 64; images A and B "which were taken under different lighting conditions" at column 8, line 67; "bring the two images into line with one another. Specifically, brightness, contrast and gamma parameters ... are used to modify image color intensity" at column 9, line 7), comprising a local gradation conversion ("once the brightness, contrast and gamma parameters are determined, they are applied to image A" at column 10, line 27; it can be seen from equation 9 that the parameters are applied to each and every pixel as designated by "x,y" and thus the brightness conversion is local, or takes place in local areas) that minimizes a sum of squares of differences between the brightness of the first and second images ("seeks to match as best possible the color intensities of image A ... using a least sum of squares error criterion ... it seeks to minimize the deviation between the color intensities" at column 9, line 23; see equations 3). It would have been obvious at the time the invention was made to one of ordinary skill in the art

to measure and correct the brightness differences between the images of Lee/Maeda/Michael, using the minimization of sum of least squares method taught by Tao, in order to reduce variations "due to different lighting conditions" in which the images were acquired (Tao, column 2, line 64), and thereby "bring the two images into line with one another" and specifically, with respect to "brightness, contrast and gamma parameters" (Tao, column 9, line 7), in a speedy and efficient manner (i.e., Tao, "fast modification of the image ... avoiding the need to compute equation (2) repeatedly" at column 10, line 65). In summary, the teaching of Tao would allow for all of the image parameters (i.e., brightness, contrast and gamma) to be normalized between the two images of Lee, instead of just the brightness alone as required, thereby providing a more accurate image normalization and thus further helping to reduce the indication of false defects due to mismatched images (Lee, column 6, line 16).

10. Claims 19 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Lee et al. (US 5,808,735 A – art of record), Maeda et al. (US 5,153,444 A – new art) and Michael (US 5,640,200 A – art of record) as applied to claim 27 above, and further in combination with Wagner et al. (US 5,659,172 – art of record). The Lee/Maeda/Michael combination does not disclose picking up the first and second images using an electron beam. Wagner discloses a system in the same field of endeavor of semiconductor wafer inspection ("detection of defects on semiconductor wafers" at column 1, line 11), comprising picking up images to be inspected using an electron beam (figure 1, numeral 32; see "SEM 22 electron beam 32" at column 4, line

64; "images of an area of the semiconductor wafer which is to be inspected" at column 3, line 2). It would have been obvious at the time the invention was made to one of ordinary skill in the art to utilize an electron beam scanner as taught by Wagner, as the image pick-up source of the Lee/Maeda/Michael combination, in order to detect defects the size of which "falls below the resolution of conventional light optics" (Wagner, column 1, line 43) because of the scanning microscope's ability to resolve "features more that an order of magnitude smaller than the wavelength of visible light" (Wagner, column 1, line 51), thereby improving defect detection sensitivity and thus accuracy.

11. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Lee et al. (US 5,808,735 A – art of record), Maeda et al. (US 5,153,444 A – new art) and Michael (US 5,640,200 A – art of record) as applied to claim 15 above, and further in combination with Haskell et al. (US 6,111,596 – art of record). The Lee/Maeda/Michael combination does not teach a linear conversion of the gain and offset so that the brightness of the images can be made equal. Haskell discloses an image process system in the same area of adjusting two images so that their overall brightness is the same ("mismatch in brightness and/or color balance between the two views of a scene due to differences in imaging parameters is rectified" at column 4, line 15), comprising matching the brightness of two images by means of a linear conversion of gain and offset ("gain and offset differences not only for luminance but also for chrominance are corrected" at column 4, line 13; specifically, see "Method 1" at column 6, line 20; "gain and offset values that must be applied to the right-view image to correct

for mismatch can be obtained by solving two simultaneous equations" at column 6, line 34; the equation for gain, "a", is at column 6, line 47 and offset, "b" at line 43; the equations are linear [i.e., not exponential] and thus the correction is linear). The technique of method 1 is best applied to "images having histograms with at least two uniquely identifiable points with ... 'very dark' and 'very bright' contents" as described at column 6, line 21. It would have been obvious at the time the invention was made to one of ordinary skill in the art to modify the Lee/Maeda/Michael combination by matching the brightness of the Lee using a linear conversion of gain and offset as taught by Haskell, in order to more accurately correct for image brightness difference by factoring in both gain and offset, as opposed to just a simple histogram adjustment as is currently disclosed by Lee, and to provide the additional benefit of correcting a chrominance mismatch (in addition to the luminance, or brightness) thereby providing Lee the ability to utilize color images, to more accurately represent the semiconductor under inspection.

12. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Lee et al. (US 5,808,735 A – art of record), Maeda et al. (US 5,153,444 A – new art) and Michael (US 5,640,200 A – art of record) as applied to claim 15 above, and further in combination with Wihl (US 4,633,504 A – art of record). While the Lee/Maeda/Michael combination teaches a monitor for displaying inspection related information (Lee, figure 1, numeral 60), Lee does not explicitly teach displaying information of a brightness, a local contrast or a local average of the first and second

images. Wihl discloses an optical inspection system comprising comparing first and second images for a defect, wherein Wihl teaches displaying brightness information of the first and second images ("visual display of the inspected die" at column 4, line 67; both dies are inspected, and the operator can view either; a visual display of the actual die is a display of the brightness information of the die). It would have been obvious at the time the invention was made to one of ordinary skill in the art to display (using the display of Lee) the inspection images of the Lee/Maeda/Michael combination as taught by Wihl, in order to provide the operator with the opportunity to view the actual inspection images himself to further ensure that no defects were missed by the automated inspection, and/or to verify the automated inspection results.

Conclusion

13. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

14. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brian P. Werner whose telephone number is 703-306-3037. The examiner can normally be reached on M-F, 8:00 - 4:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Leo H. Boudreau can be reached on 703-305-4706. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9314 for regular communications and 703-872-9314 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-305-4750.

Brian Werner
Primary Examiner
November 28, 2003

BRIAN WERNER
PRIMARY EXAMINER